INVESTIGATION OF ANOMALOUS DENSITIES OF HIGH–ENERGY ALPHA–PARTICLES TRACKS IN CR-39 DETECTORS DURING ELECTROLYSIS OF HEAVY WATER ON PALLADIUM CATHODES

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Recently, several researchers claim the finding of anomalous alpha-particles generation during very simple electrolysis experiments with heavy water and palladium cathodes. The phenomenon seems to improve if deuterium formation on the cathode is associated with deposition of palladium nanostructures coming from chlorides of the same metal present in the electrolytic solution. Due to the relevance of the claims and considered the simplicity of the experimental apparatus, several tests have been performed in order to confirm the claimed results. The results of these tests will be the object of this scientific report.

Investigation of anomalous densities of high-energy alpha-particles tracks in CR-39 detectors during electrolysis of heavy water on palladium cathodes.

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Oriani's claims

Abstract

A relatively simple technique using CR39 particle detectors has been developed that in 25 consecutive electrolyses has reproducibly produced charged particle tracks, showing unambiguous evidence of a nuclear reaction during electrolysis of heavy or light water solutions. Nuclear tracks can be produced upon the surface and beyond the 1 mm thickness of the CR39 detectors. Nuclear activity of some sort can persist in the Viton o-rings used in the electrolysis cell so that charged energetic particles can be generated subsequently without electrolysis.

Repeatable technique for the generation of a nuclear reaction during electrolysis

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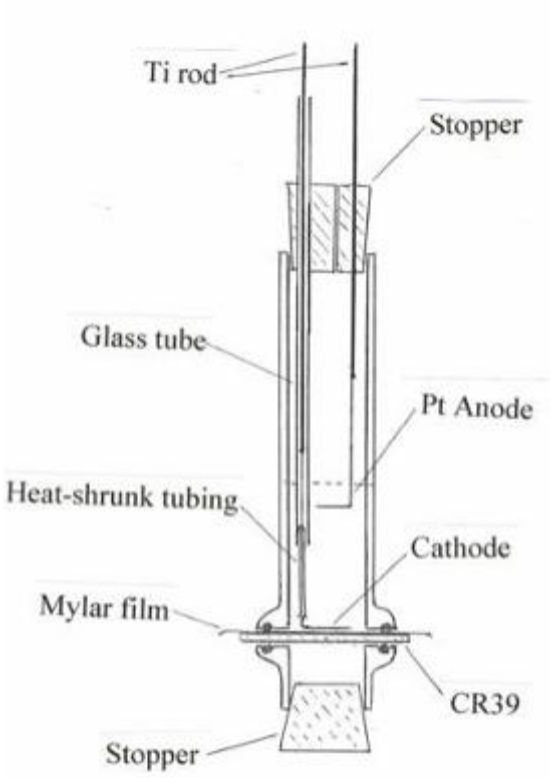
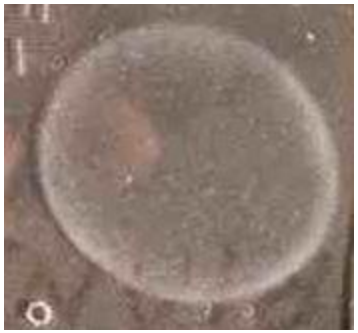
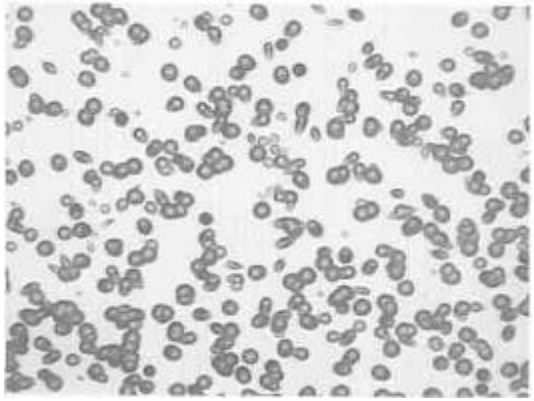






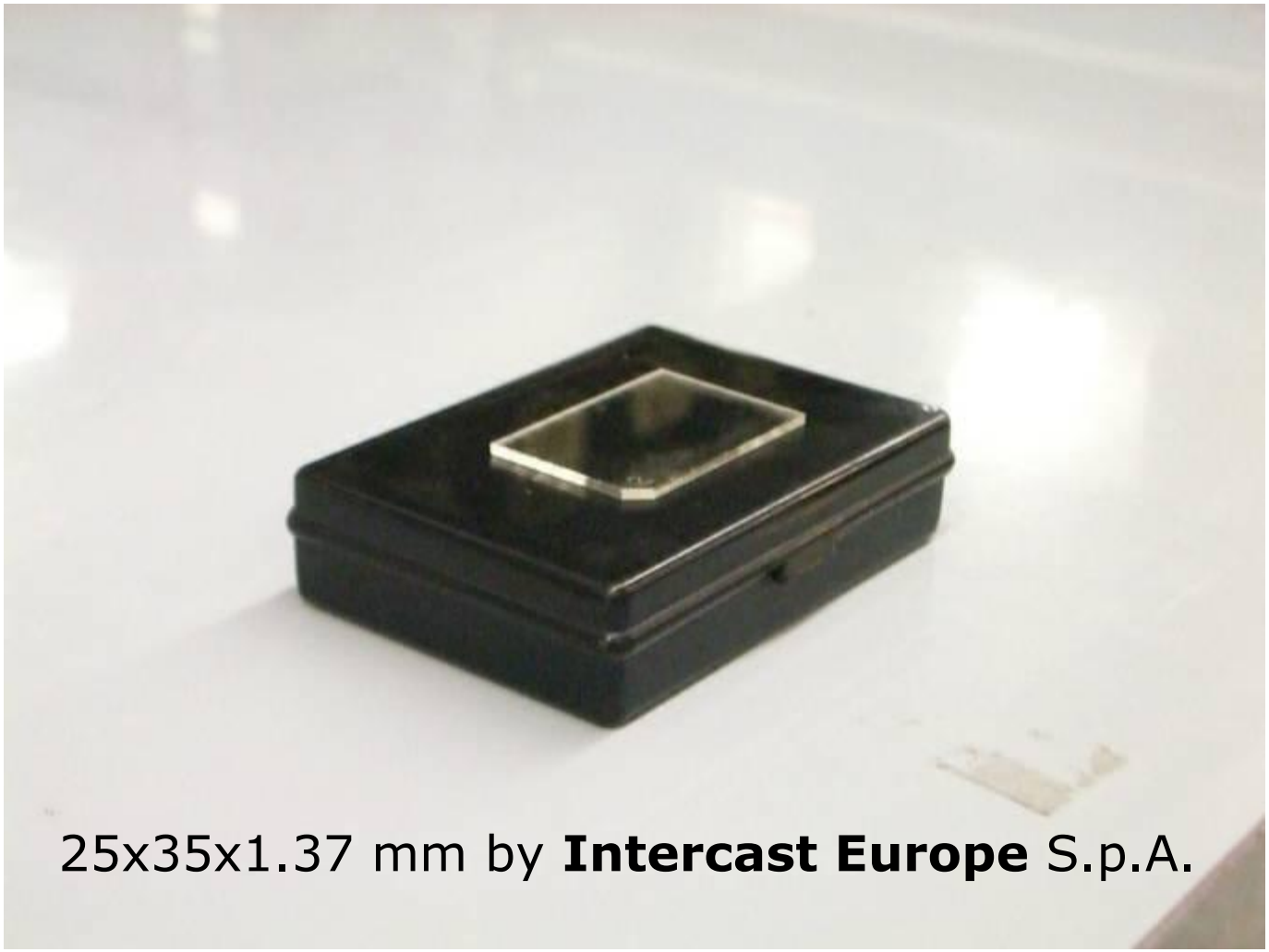
Oriani's results

- Examination showed that haze patterns following the circumference of the o-rings had developed, similar to that illustrated by Fig.5. However, the central regions of the areas bounded by the haze rings were clear. The track densities were 55 tracks/cm^2 on one chip and 70 on the other. These numbers are to be compared with the background value of 55 per cm2 and with over 2000 tracks /cm^2 found in the center of the chip pictured in Fig.5.

AIM OF EXPERIMENT

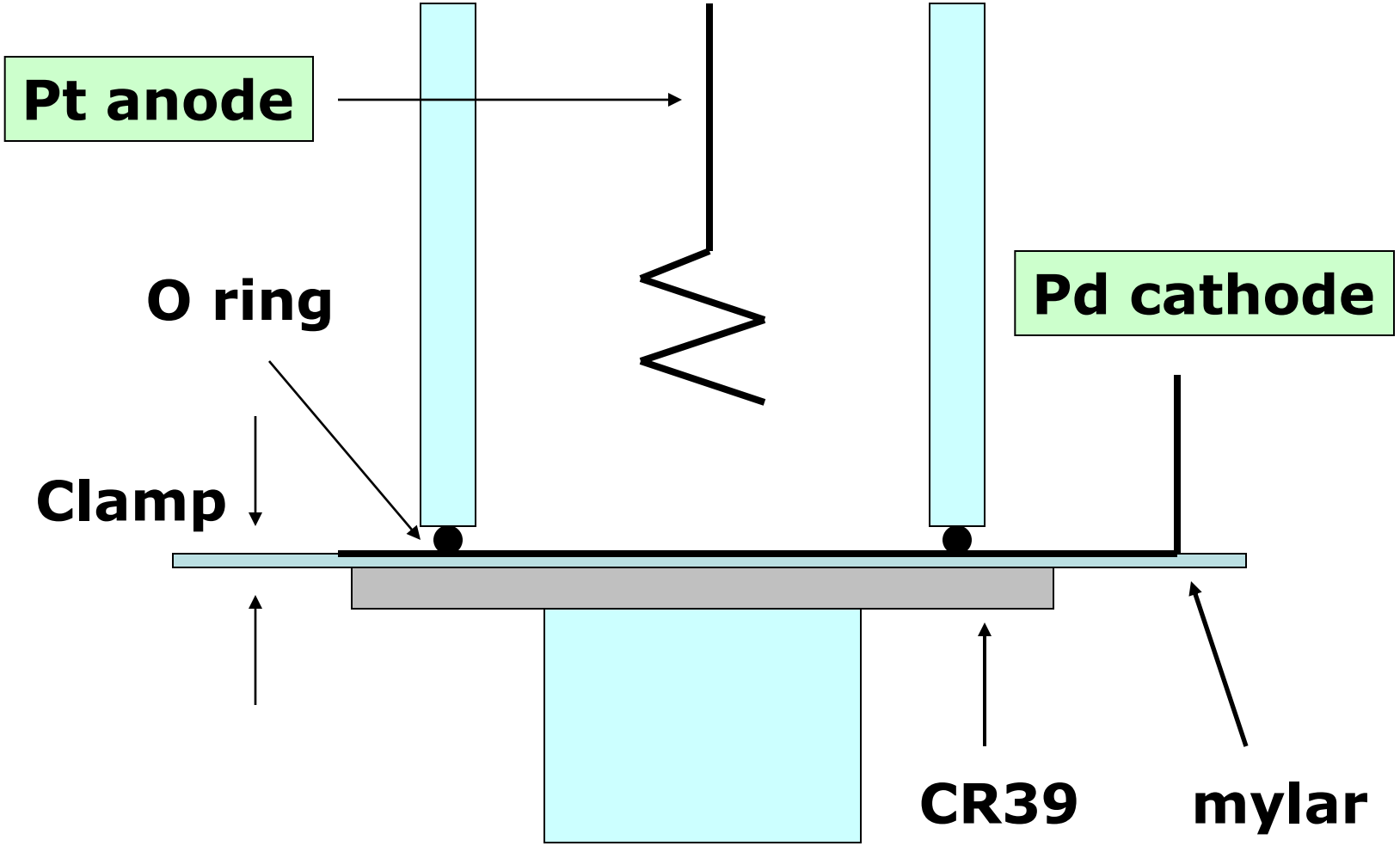
- To detect alpha particles emission from Pd cathode during electrolysis D loading using a standard plastic detector for measurements of radon in the environment
- Expected tracks density from Pd cathode should be significantly higher than noise level

CR 39 TRACK DETECTOR



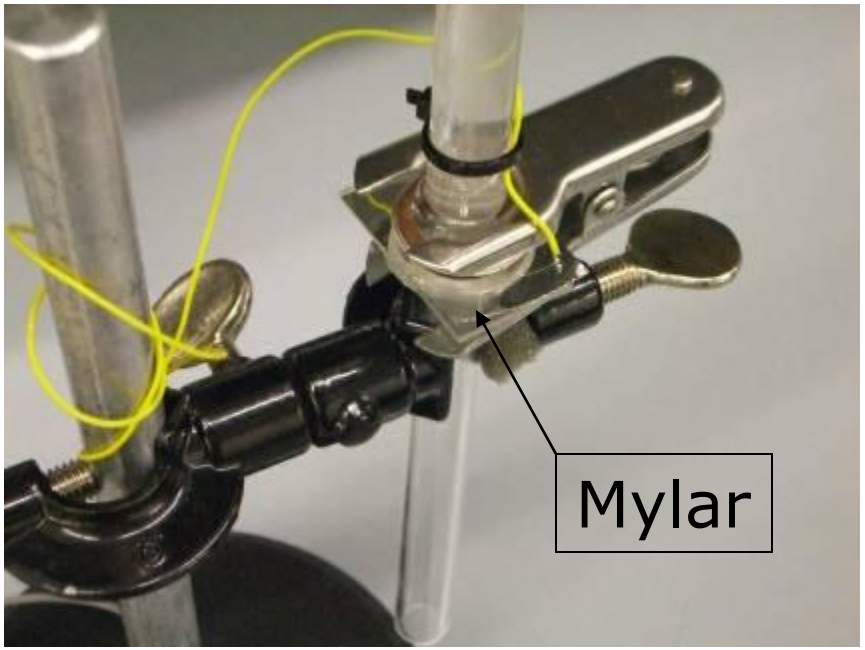
25x35x1.37 mm by **Intercast Europe** S.p.A.

ELECTROLYSIS CELL



HIGHLIGHT OF MYLAR - CR39 ASSEMBLY

CR 39



WHY MYLAR?

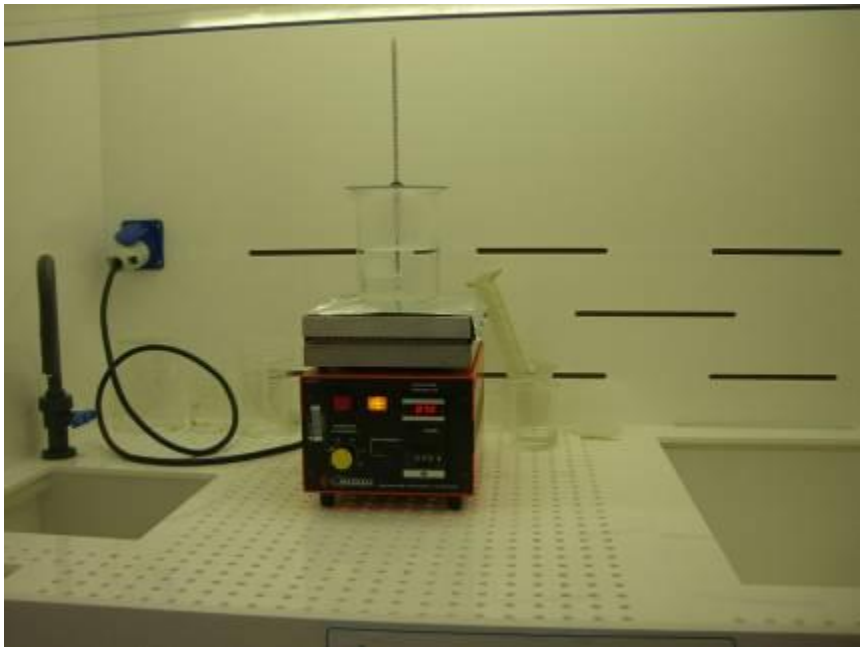
- Mylar interposed between Pd cathode and CR 39 prevents this one to be etched or contaminated by electrolytic solution during D loading
- Artifacts on CR 39 plate can produce wrong interpretation of results. We think this happened in some experiments from others experimentalist

ELECTROLYSIS PARAMETERS

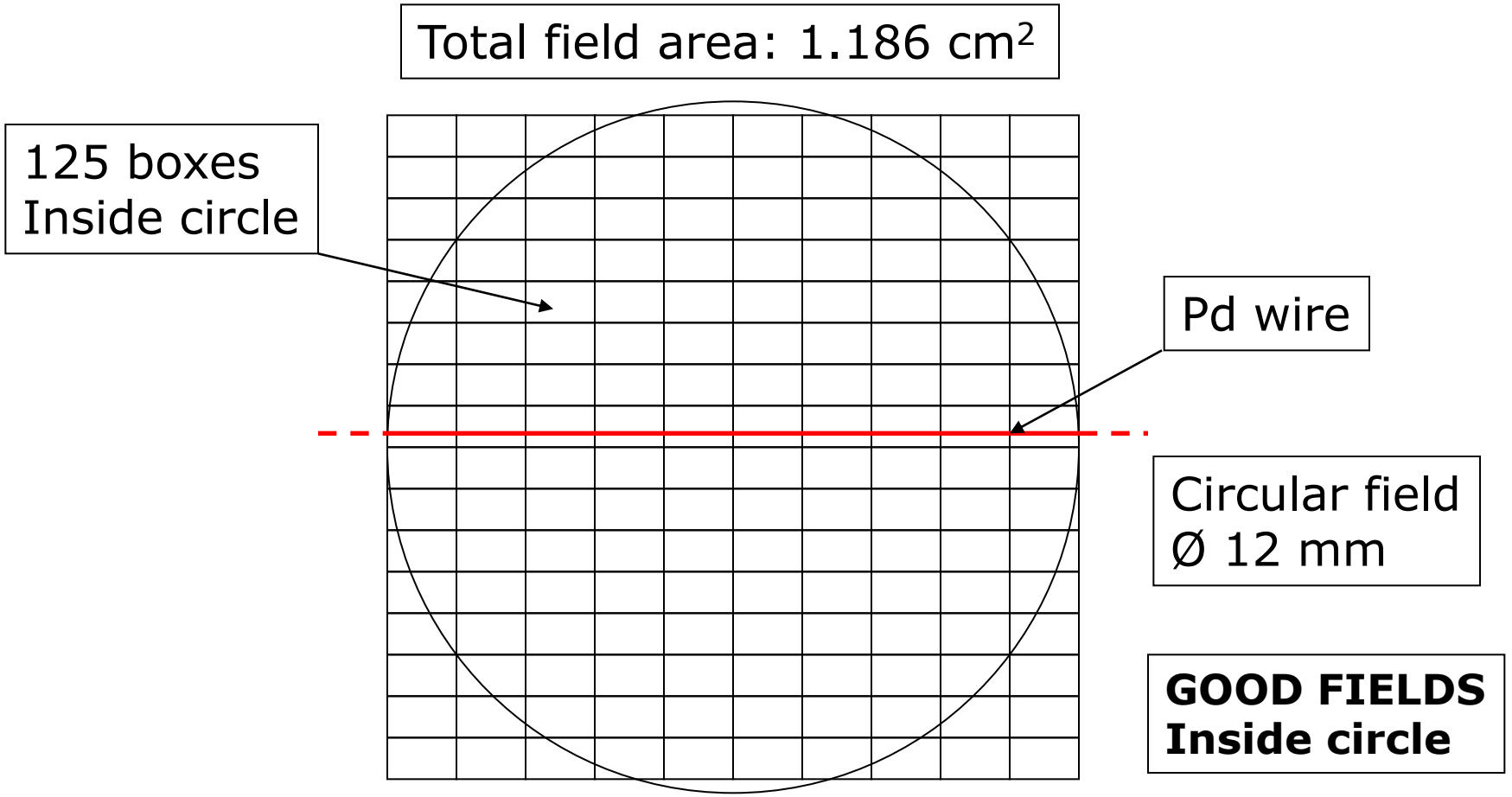
- LiCl 0.5 M in 10 mL D_2O
- I_c :10 mA; (~ 0.5 A/cm^2)
- Cathode :Pd wire, Ø 50 µm, 12 mm lengh
- Anode :Pt spiral wire
- Mylar 11 µm thick
- Time: 3 – 7 days

ETCH CONDITIONS

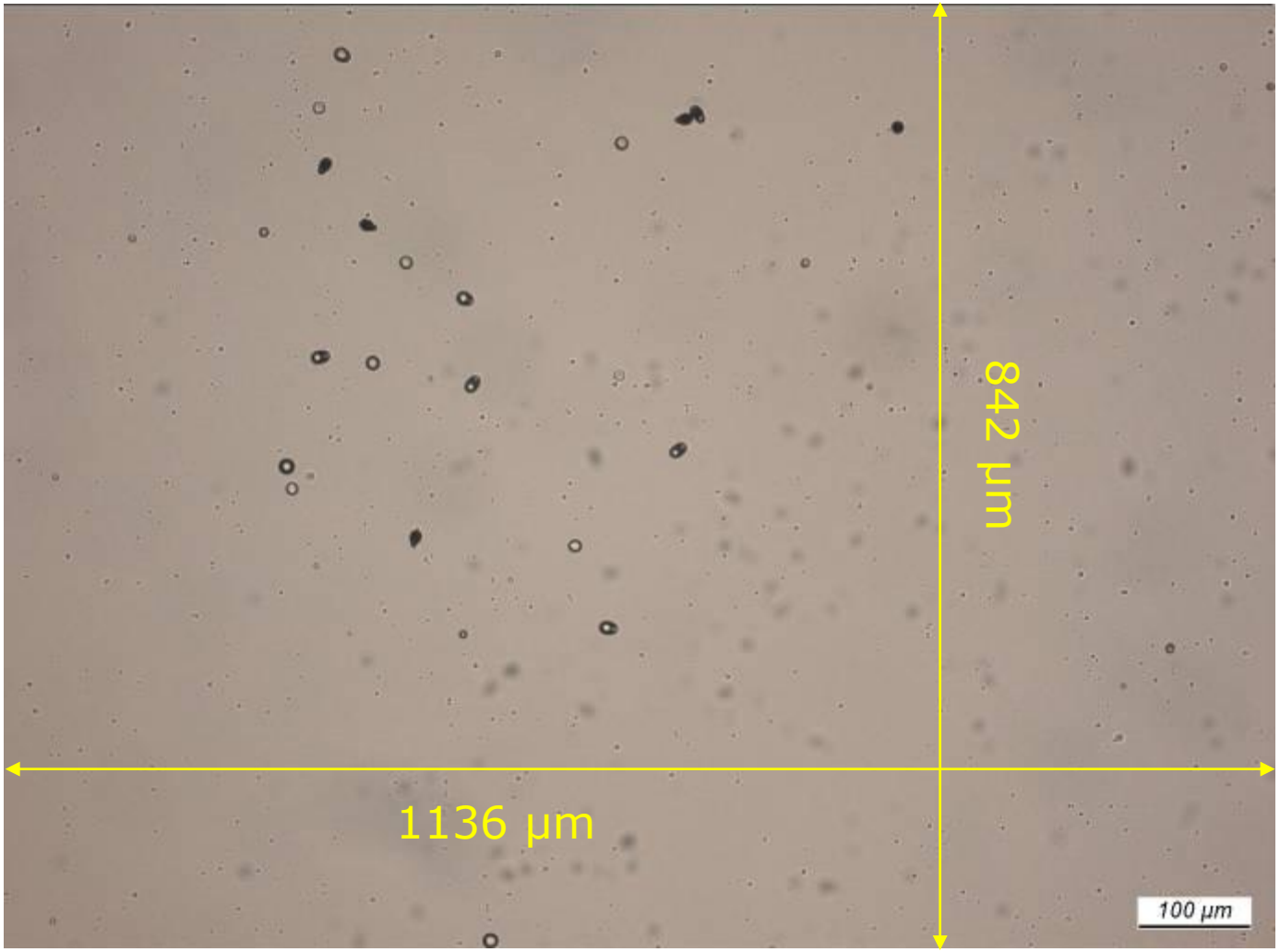
- NaOH 6.25 M @ 70°C for 6 hours
- Heating plate with electronic temperature control
- Thermometer for T° stability check



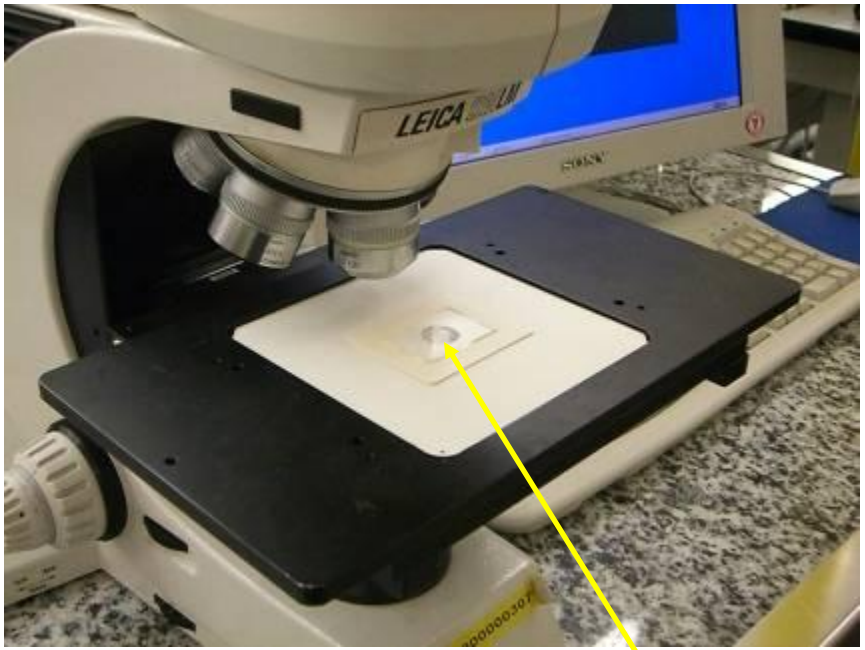
FIELD SCAN GRID



BOX SIZE



TRACKS COUNT SYSTEM



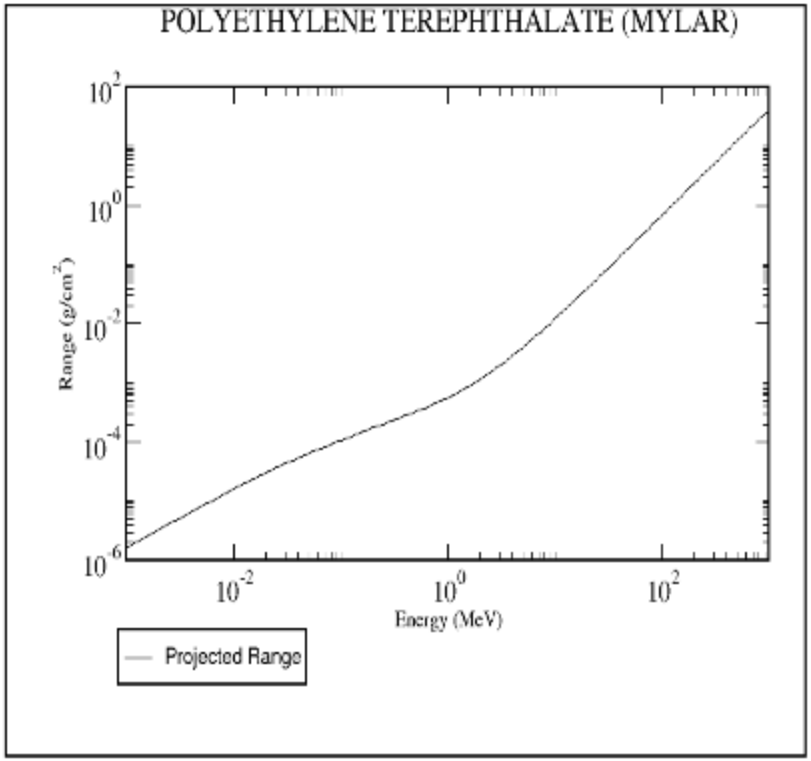
BETHE-BLOCK FORMULA

- SRIM® and NIST® software were used to calculate stopping power *dE/dx* and projected range of alpha particles in mylar
- Projected range for alpha 2.50 MeV is 10.99 µm
- Alpha particles with E > 2.50 MeV cross mylar and leave tracks on CR 39 11 µm th.

POLYETHYLENE TEREPHTHALATE (MYLAR)

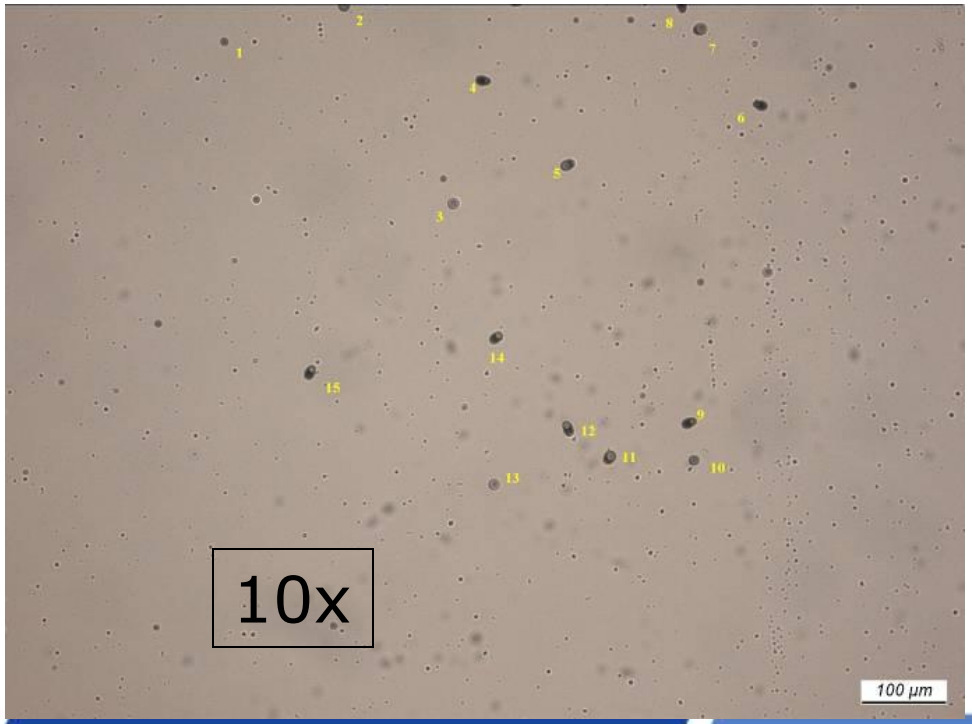
COMPOSITION:	
Density (g/cm^3) =	1.40000E+00
Mean Excitation Energy	78.700000 (eV)

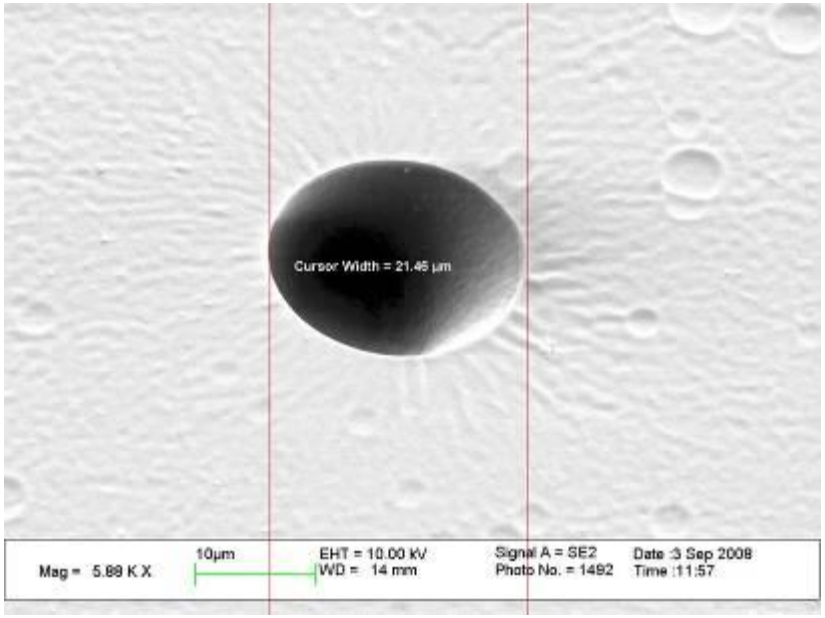
Atomic number	Fraction by weight
1	0.041959
6	0.625017
8	0.333025



Range = ρx

CR 39 TRACKS AFTER ETCH



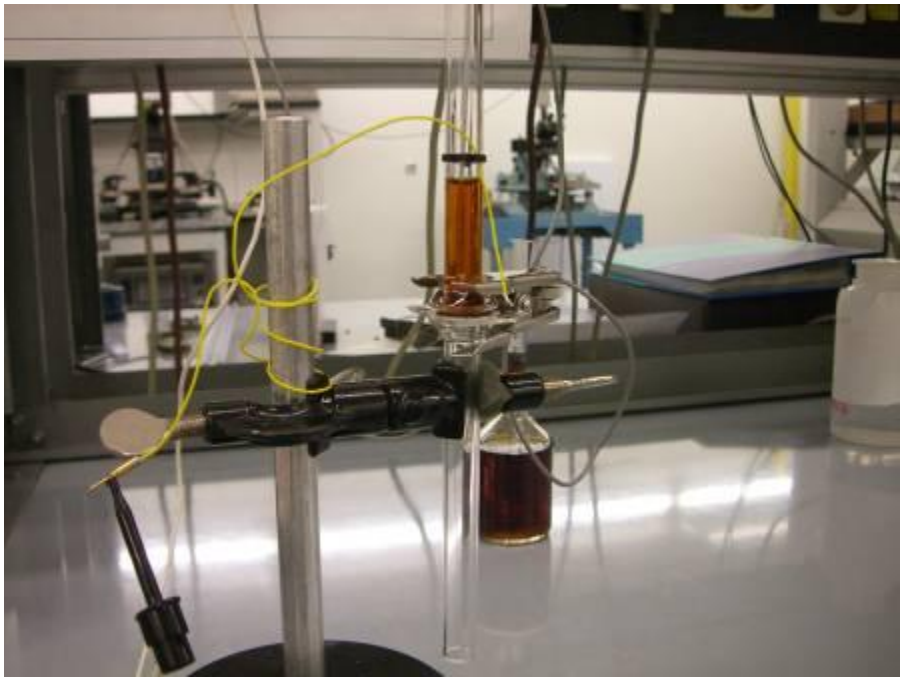


MATRIX OF TRIALS

- 2 Blank Test with D_2O + $LiCl_2$; NO ELECTROLYSIS
- 5 Electrolysis Test with D_2O + $LiCl_2$
- 2 Electrolysis Test with D_2O + $LiCl_2$ + PdCl
- 1 Electrolysis Test, NO MYLAR

CODEPOSITION

- Codeposition of Pd / D from $PdCl_2$ in D_2O
- $PdCl_2$ 0.05 M + LiCl 0.5 M
- Trial 1: 10 mA
- Trial 2: 0.5 mA till total plating, ramp to 5-10-20-40-80 mA



RESULTS

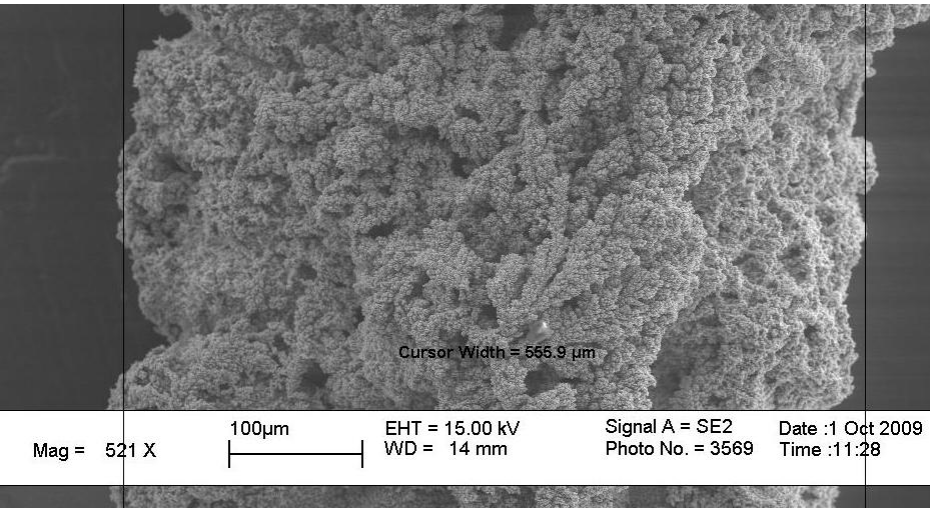
BLANK	
	D (cm^{-2})
EX.1	189
EX.2	154

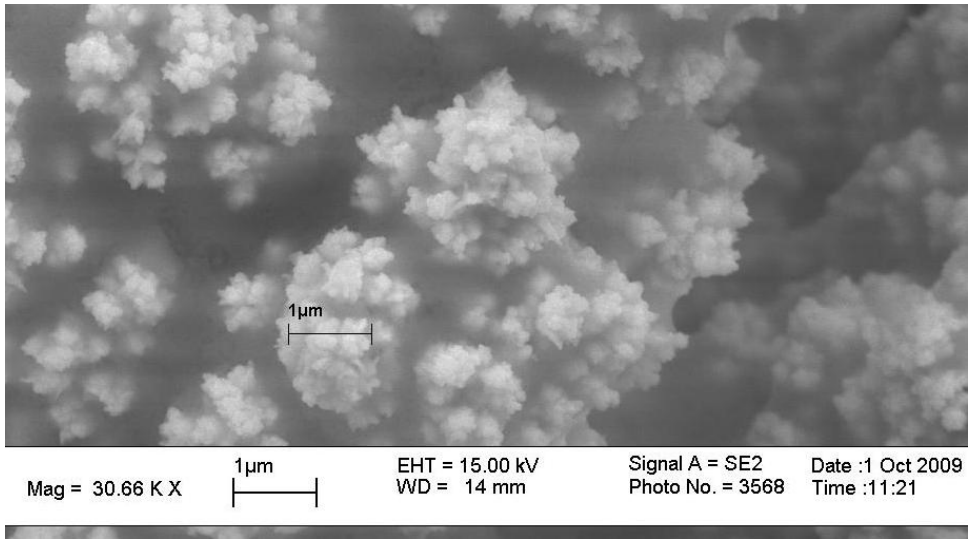
Tab. 3 – Track Density (Codepos.)

Exp. -A-	113 tr./cm^2
Exp. -B-	146 tr./cm^2

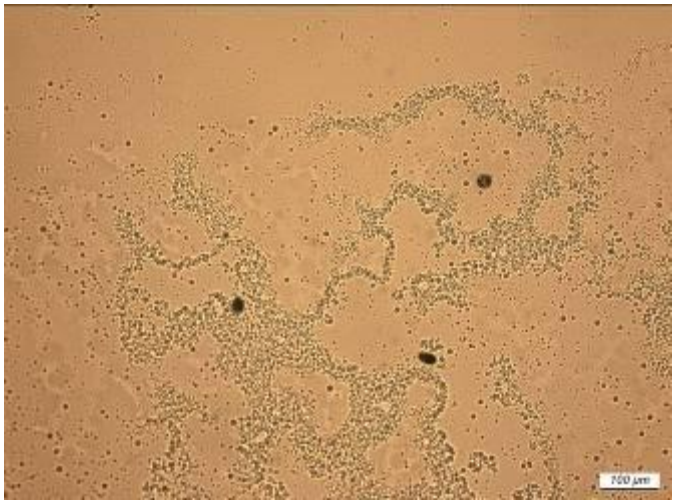
ELECTROLYSIS	
	D (cm^{-2})
EX.1	222
EX.2	296
EX.3	136
EX.4	112
EX.5	74

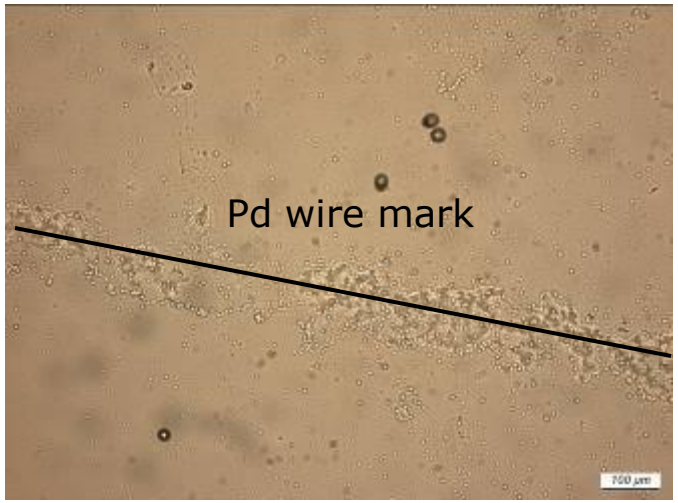
Pd WIRE AFTER Pd/D CODEPOSITION (SEM)



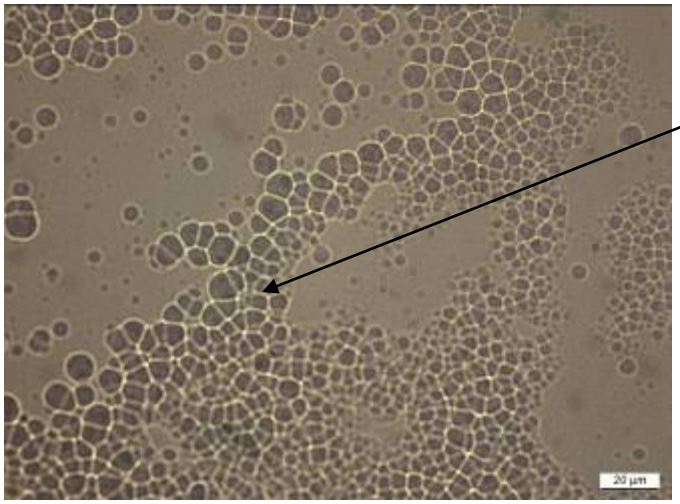


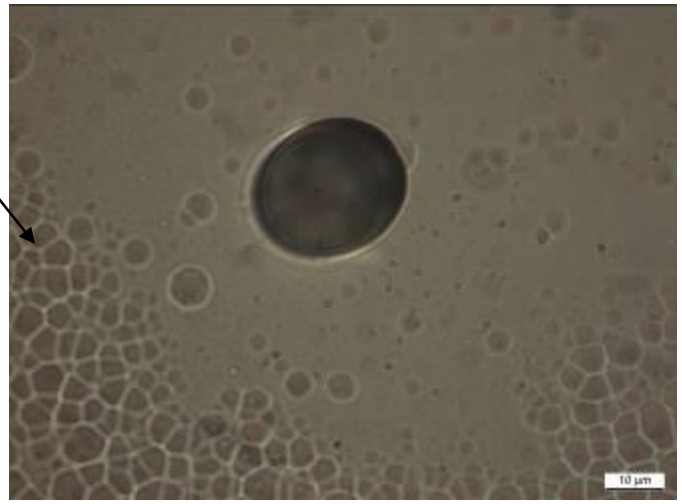
NO MYLAR - OPTICAL



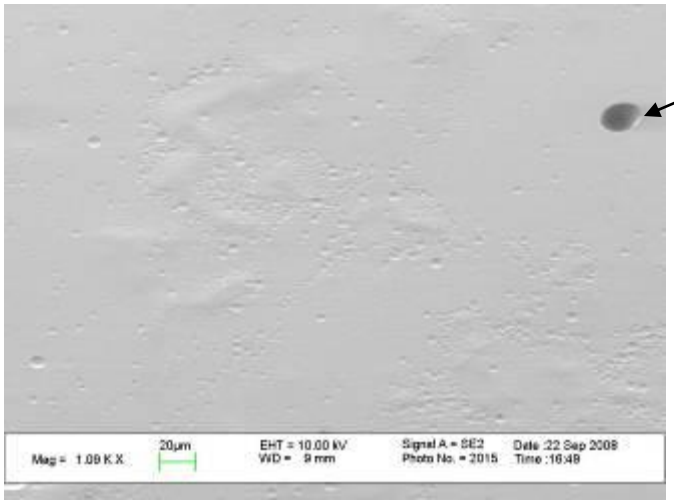


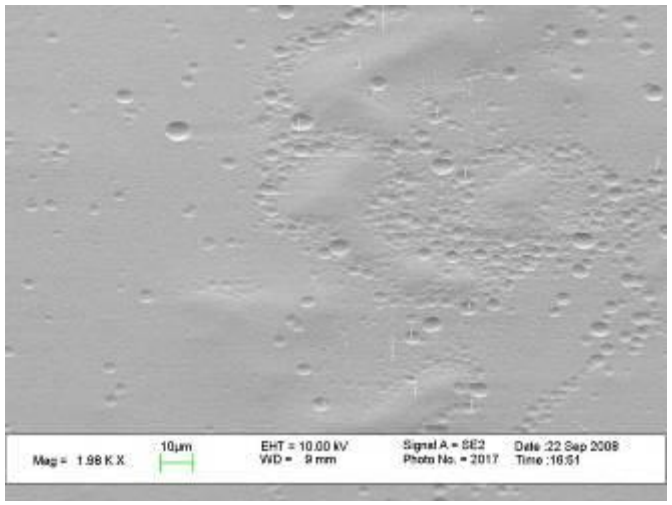
"BOUBBLE"
PITS



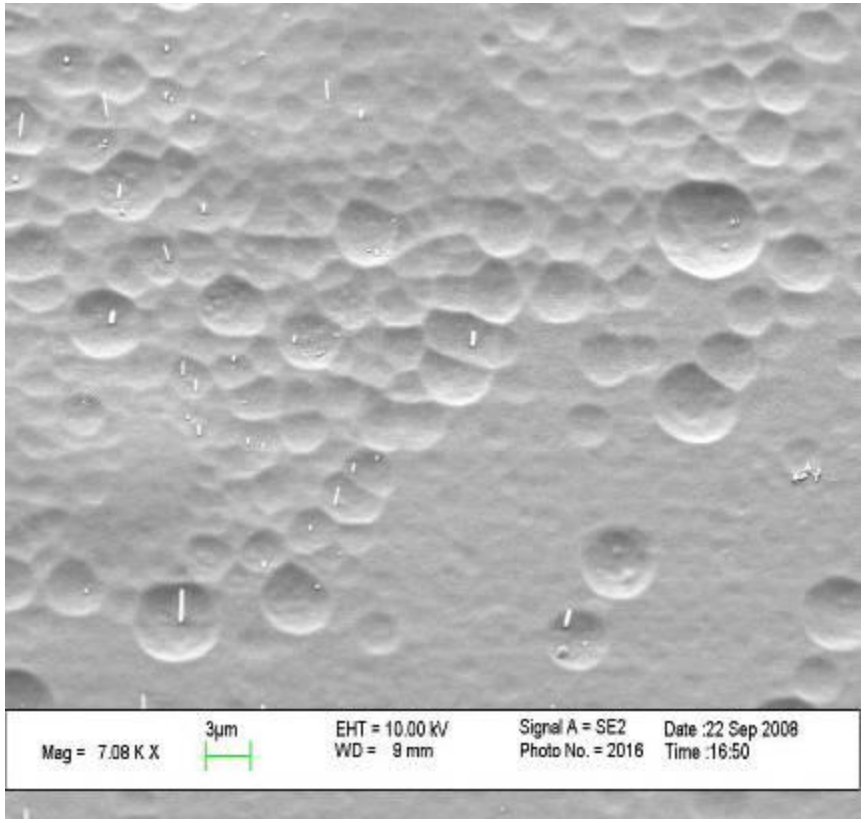


NO MYLAR - SEM





SURFACE DAMAGE

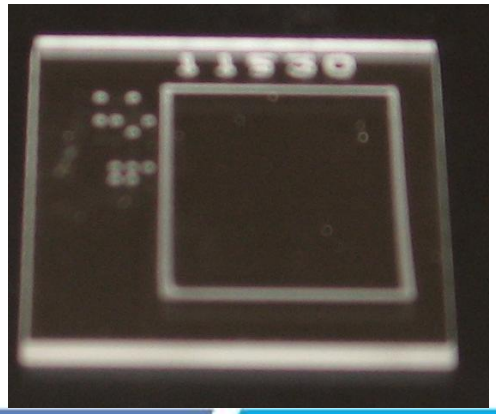


OBSERVATIONS

- Experiments with mylar between electrolyte and CR39 give a pit density of same magnitude compared with blank (no current) test; in one case less.
- Pits appearance in test without mylar is strictly different from nuclear tracks visible on the same chip
- Under the Pd cathode mark there is not an increase of pit density respect to the neighbor

CONCLUSIONS

- No meaningful evidence of specific particle emission with E>2.5 MeV during D_2O electrolysis (comparable track count), with or without Pd codeposition;
- Similar results reported on site www.earthtech.com
- New experiments already started with CR39 TASTRAK detectors from "Trak analysis system ltd"



Acknowledgments

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- Dr. G. Iori (Intercast) for CR-39 detectors;

Thank you for the attention